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DOCKET NO.  
50364-00006USPT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Ulf A. PERSSON et al.  
U.S. Serial No.: 09/935,459  
U.S. Filing Date: August 23, 2001  
Art Unit: Not Yet Assigned  
Priority Claim: EP 00118760.8  
Priority Date: August 30, 2000  
Title of Invention: OPTICAL COMMUNICATION SYSTEM  
Attorney Docket No.: 50364-00006USPT

Assistant Commissioner for Patents  
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CLAIM OF PRIORITY UNDER 35 U.S.C. § 119

Under the provisions of 35 U.S.C. §119 Applicants hereby claim the priority of  
European patent application No. 00118760.8 as filed on August 30, 2000, which is identified  
in the declaration of the above-identified application. A certified copy of the priority  
document is filed herewith.

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Applicants believe that no further information or documentation in support of the  
priority claim will be required.

Respectfully submitted,

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Enclosure

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**Bescheinigung**

**Certificate**

**Attestation**

Die angehefteten Unterlagen stimmen mit der ursprünglich eingereichten Fassung der auf dem nächsten Blatt bezeichneten europäischen Patentanmeldung überein.

The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

**Patentanmeldung Nr.    Patent application No.    Demande de brevet n°**

**00118760.8**

Der Präsident des Europäischen Patentamts;  
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets  
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**Blatt 2 der Bescheinigung  
Sheet 2 of the certificate  
Page 2 de l'attestation**

Anmeldung Nr.:  
Application no.:  
Demande n°: 00118760.8

Anmeldetag:  
Date of filing:  
Date de dépôt: 30/08/00

Anmelder:  
Applicant(s):  
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Bezeichnung der Erfindung:  
Title of the invention:  
Titre de l'invention:  
Optical communication system

In Anspruch genommene Priorität(en) / Priority(ies) claimed / Priorité(s) revendiquée(s)

Staat:  
State:  
Pays:

Tag:  
Date:  
Date:

Aktenzeichen:  
File no.  
Numéro de dépôt:

Internationale Patentklassifikation:  
International Patent classification:  
Classification internationale des brevets:  
H04J14/02

Am Anmeldetag benannte Vertragsstaaten:  
Contracting states designated at date of filing: AT/BE/CH/CY/DE/DK/ES/FI/FR/GB/GR/IE/IT/LI/LU/MC/NL/PT/SE/TR  
Etats contractants désignés lors du dépôt:

Bemerkungen:  
Remarks:  
Remarques:

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Optical communication system

Field of invention

5 The invention relates to optical communication systems. It has particular relevance to communication systems carrying WDM traffic channels.

Background art

10 Optical communication systems employing wavelength division multiplexing (WDM) use a single fibre to carry multiple traffic channels within a predetermined wavelength band. WDM systems are being deployed increasingly to optimise the transmission capacity of existing networks. Conventional WDM systems typically operate in a wavelength window centred around 1550nm. They also typically use at least one service channel  
15 for carrying system information, for example network control information and control signals. This channel is often carried on the same optical fibre as the traffic information, but outside the traffic carrying bandwidth. For example, a service channel commonly used with the 1550 waveband is carried on the 1510nm wavelength.

20 Many optical systems in use today operate in the 1300nm window. An example is the SONET/SDH. While WDM systems have obvious advantages, their introduction involves considerable investment as new equipment must be installed and maintained even in existing networks. The process is therefore a  
25 gradual one. When introducing WDM traffic to existing networks, operators are often obliged to maintain the previous service, at least for a time. The simultaneous operation of a WDM system operating in the 1550nm window with other services centred round the 1300nm waveband on the same network, and within the same nodes, requires certain measures to prevent interference  
30 between the two services. This includes the installation of filter components,

which may comprise simple fused couplers or thin film filters for separating the 1300nm waveband from the 1550nm waveband. In non-amplified WDM systems, filter components are necessary for separating out the service channel at each node. However, each filter component causes a basic power loss to channels passively relayed through the filter. The additional 1550nm/1300nm couplers along any single link will naturally increase the total link loss, in some cases to a level that exceeds the allowable link loss, such that the WDM system cannot be utilised over the whole network.

There is consequently a need for an arrangement that can allow WDM systems operating in a first wavelength band to be used on existing optical networks at the same time as optical systems operating in a second, different wavelength band.

## SUMMARY OF INVENTION

The invention meets the above need by the provision of a node in an optical communications network that has a first set of add/drop filter elements for extracting and combining optical signals carried on wavelength division multiplexed channels in a first wavelength band and an extraction element and combining element for dropping and adding, respectively, a service channel associated with the wavelength division multiplexed channels. The extraction element is arranged upstream of the add/drop filter elements relative to the direction of traffic flow, and the combining element is arranged downstream of the add/drop filter elements. The extraction and combining elements are additionally adapted to drop and add, respectively, at least one further wavelength band carrying at least one optical traffic data channel.

By combining the adding and dropping of traffic channels that are separate from the WDM wavelengths with that of the service channel, the WDM traffic can be extracted, processed and combined with the transmission path in the

normal manner without the need for additional filter elements to prevent interference and without the additional imposed losses associated therewith.

5 The traffic channels carried on the second wavelength band are preferably not wavelength division multiplexed channels. However, this may not be the case, and the separation of the two bands prior to the dropping and adding of individual channels means that a second wavelength band carrying WDM traffic will likewise be protected from the additional loss of the WDM add/drop filter elements.

10 The extraction element is connected to a splitting arrangement for separating the service channel wavelength from the second wavelength band. The separated wavelengths can then be converted to electrical signals and processed separately. The second wavelength band and service channel wavelength are furthermore combined using a coupling arrangement which  
15 then relays the combined signals to the combining element.

Advantageously, a bypass path can be provided for the second wavelength band between the splitting arrangement and the coupling arrangement. The  
20 second wavelength band is thus merely removed from the transmission path to allow the WDM channels to be extracted from the transmission path, processed and added to the transmission path.

25 The second wavelength band is preferably arranged on the same side of the wavelength spectrum as the service channel wavelength relative to the first wavelength band, as this greatly simplifies the construction of the extraction and combining elements.

30 Preferably, the first wavelength band is centred around 1550nm, while the second wavelength band is centred around 1300nm. The service channel is

preferably carried at 1510nm.

The invention also resides in an optical network including nodes as described above.

5

## BRIEF DESCRIPTION OF THE DRAWINGS

Further objects and advantages of the present invention will become apparent from the following description of the preferred embodiments that are given by way of example with reference to the accompanying drawings. In the figures:

10

Fig. 1            schematically illustrates an optical network,

Fig. 2            schematically illustrates part of a node in an optical communications network according to a first embodiment of the present invention, and

15

Fig. 3            schematically illustrates part of a node according to a second embodiment of the present invention.

20

## DETAILED DESCRIPTION OF THE DRAWINGS

Fig. 1 shows an optical communications network comprising a number of nodes 10 connected by a bi-directional transmission path 20 constituted by optical fibres. In the simplified network shown in Fig. 1, the nodes 10 are connected to form a ring configuration, however it will be understood that the present invention may be employed in other network architectures.

25

Two communications systems are carried by the illustrated network. The first is a system carrying user traffic in the wavelength band centered around 1300nm, for example the SONET/SDH. The other system is a wavelength

30

division multiplexed (WDM) system operating in the 1550nm window. An optical service channel OSC carried at 1510nm provides system information, such as network monitoring and control information to and from each node 10 for the WDM system. Each node 10 comprises add/drop filter components for combining or extracting channels of specified wavelengths to and from the transmission path. Each wavelength that is not dropped by a filter component is passively relayed by the component, either by transmission or reflection, with a finite loss. The optical service channel OSC is also dropped at each node 10 that serves as a WDM node, i.e. a node that drops or adds WDM traffic.

Turning to Fig. 2, there is shown a schematic representation of part of a node 10 according to a first embodiment of the present invention. The figure specifically shows the arrangement of add/drop elements for a node wherein traffic channels carried in the 1300nm wavelength window denoted by  $B_{1300}$  and wavelength division multiplexed traffic channels carried in the 1550nm window denoted by  $B_{WDM}$  are added to the network and dropped from the network. Since the node 10 serves WDM traffic, the optical service channel carried at wavelength 1510nm and denoted by  $\lambda_{OSC}$  is likewise dropped and added at the node 10.

The data carried by wavelengths  $B_{1300}$ ,  $B_{WDM}$  and  $\lambda_{OSC}$  arrives at the node 10 via the optical fibre transmission path 20. Only a single unidirectional fibre is shown in Fig. 2. It will be understood, however, that a second fibre may be provided for carrying information in the reverse direction. A first drop filter 100 is connected to the input fibre 20 for extracting the 1330nm wavelength window and the OSC channel. In the present embodiment, the OSC channel is carried at 1510nm. The OSC channel and the 1300nm traffic are thus carried on the same side of the wavelength spectrum relative to the WDM traffic and can be dropped from the transmission path 20 using filter having a simple

band pass or high-pass frequency transmittance characteristic. For a simple high-pass frequency characteristic, the cut-off frequency would be chosen to correspond to a suitable wavelength below, i.e. shorter than, the wavelength of the 1550nm window. Naturally, if the 1300nm or non-WDM traffic and the OSC channel were carried on wavelengths located on opposite sides of the 1550nm wavelength window, the drop filter 100 would be designed to have a high transmittance at the non-WDM traffic wavelengths and the OSC wavelength and a low transmittance in the 1550nm window. The filter 100 is preferably an interference filter, such as a thin film filter, but other filter designs are also possible, for instance a fibre grating filter such as a Bragg grating filter.

After extraction from the transmission path 20, the non-WDM channels carried on the wavelength band  $B_{1300}$  and the OSC channel at  $\lambda_{OSC}$  are fed to a further filter 110 which separates the wavelength band  $B_{1300}$  from the OSC channel wavelength  $\lambda_{OSC}$ . Filter 110 can be the same type as filter 100, i.e. preferably an interference filter. The non-WDM traffic is then processed in the usual manner by non-shown circuitry in the node 10. Information on the OSC channel is likewise received and processed by specific, non-shown circuitry as is generally known in the art.

The WDM channel wavelengths are passively relayed at filter 100 and undergo a finite power loss thereby. Depending on the filter technology utilised, the WDM channel wavelengths will be either reflected or transmitted by the filter 100. Additional add/drop filters 120, 130 are arranged on the transmission path for the WDM wavelengths, which for the sake of example will be denoted as  $\lambda_1, \lambda_1, \dots \lambda_n$ . These may take the form of multiple add/drop filters, where each filter is designed to drop and/or add a single channel wavelength  $\lambda_1, \lambda_2, \dots \lambda_n$ , from among all the WDM channels. Alternatively, the filters 120, 130 may take the form of a demultiplexer and multiplexer,

respectively, for dropping/adding multiple channels  $\lambda_1, \lambda_2, \dots \lambda_n$  together and subsequently separating these into the individual wavelengths. It will be appreciated that any combination of wavelengths may be dropped and added by the elements 120 and 130 depending on the connections required in the network. The possible configurations are generally known in the art and will not be described further here.

Downstream of the final add filter 130 non-WDM traffic and the OSC channel are again added to the transmission path 20 using a coupler 140. The wavelengths of the non-WDM traffic  $B_{1300}$  and the OSC channel  $\lambda_{OSC}$  are combined upstream of this coupler 140 in a separate coupler 150. The couplers 140, 150 are preferably of the same type and design as filters 100 and 110, respectively, but may be of any suitable structure.

By dropping and adding both the non-WDM traffic and the OSC channel with the same add/drop filter the loss suffered by the WDM traffic channels is limited to that imposed by a single filter. This is of great advantage for non-amplified WDM systems, since each additional add/drop filter on the transmission path imposes a finite power loss on the channels. Each loss in power is equivalent to a specific length of optical fibre, so ultimately the number of add/drop elements on a transmission path limit the useful size of a network for WDM traffic. In conventional WDM systems the OSC channel is generally dropped for processing before the WDM traffic channels and recombined with the transmission path after any WDM channels have been added. Combining the extraction and addition of the non-WDM traffic channels with that of the OSC channel allows the network to be utilised simultaneously for different optical communication systems without imposing additional power loss on WDM channels.

In a further embodiment of the present invention the non-WDM traffic is not

processed at the node 10 but merely transmitted through the node. This is shown schematically in Fig. 3. The arrangement in Fig. 3 is almost identical to that of Fig. 2 with the exception that the non-WDM traffic at the 1300 wavelength band  $B_{1300}$  is not extracted for processing, but is instead transmitted directly to the coupler 150 for combining with the new information on the OSC channel  $\lambda_{OSC}$ . The non-WDM traffic is thus essentially bypassed. In addition to limiting the power loss imposed on the WDM channels, this arrangement also permits the standard WDM add/drop elements 120, 130 to be used. If the non-WDM traffic channels in the 1300nm wavelength band were transmitted through the node with the WDM channels, the filters 120, 130 would need to be specially adapted to prevent the two wavelength bands  $B_{1300}$  and  $B_{WDM}$  from interfering with one another.



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## Claims:

- 5           1.     A node (10) in an optical communication network, said node being  
connected a transmission path for carrying multiple traffic data  
channels including wavelength multiplexed channels carried in first  
wavelength band and at least one service channel associated with said  
wavelength division multiplexed channels and carried on at least one  
10           further wavelength separate from said wavelength band, said node  
including  
a set of first filter elements (120, 130) for adding at least one of said  
wavelength division multiplexed data channel wavelengths to said  
transmission path and/or dropping at least one of said wavelength  
15           division multiplexed channel wavelengths from said transmission path  
(120, 130),  
an extraction element (100) for dropping said at least one service  
channel wavelength from said transmission path, said extraction  
element being arranged upstream of said first set of filter elements, and  
20           a combining element (140) for adding at least one service channel  
wavelength to said transmission path, said combining element being  
arranged downstream of said set of first set of filter elements,  
characterised in that  
said extraction and combining elements (100, 140) are adapted to drop  
25           and add, respectively at least one second wavelength band in addition to  
said at least one service channel wavelength, and passively relay said  
first wavelength band. said second wavelength band being separate  
from said first wavelength band and carrying at least one optical traffic  
data channel.
- 30

2. A node as claimed in claim 1, characterised in that said second wavelength band carries non-wavelength-division-multiplexed traffic channels.
- 5 3. A node as claimed in claim 1 or 2, characterised in that said at least one service channel wavelength and said second wavelength band are arranged on the same side of the wavelength spectrum relative to said first wavelength band, wherein said extraction element (100) and said combining element (140) drop and add, respectively all wavelengths on  
10 the side of the spectrum containing said service channel wavelength and second wavelength band.
4. A node as claimed in any one of claims 1 to 3, characterised by splitting means (110) arranged to receive optical signals from said extraction  
15 element (110) and to separate said service channel wavelength from said second wavelength band.
5. A node as claimed in any one of claims 1 to 4, characterised by coupling means (150) arranged to feed optical signals to said combining  
20 means (140) and to couple said service channel wavelength with said second wavelength band.
6. A node as claimed in claims 4 and 5, characterised in that said splitting means (110) are directly connected to said coupling means (150) for  
25 relaying signals carried on said second wavelength band from said splitting means to said coupling means.
7. A node as claimed in any previous claim, characterised in that said first wavelength band is centred around 1550nm and said second  
30 wavelength band is centred around 1300nm.

8. A node as claimed in claim 7, characterised in that said service channel is carried at 1510nm.
- 5 9. An optical communications network for carrying a first wavelength band carrying wavelength division multiplexed optical data channels and a second wavelength band carrying at least one optical service channel associated with said wavelength division multiplexed channels, and including optical nodes (10) connected to a transmission path (20),  
10 each node (10) having a first set of add/drop elements (120, 130) for adding and dropping optical data channels carried in said first wavelength band and second add/drop elements (100, 140) for adding and dropping, respectively, channels carried in said second waveband, wherein said second drop element (120) is arranged upstream of said  
15 first set of add/drop elements and said second add element (140) is arranged downstream of said first set of add/drop elements, characterised in that said communication network carries a third wavelength band carrying optical traffic data, wherein said second  
20 add/drop elements are arranged to add/drop at least said third wavelength band in addition to said second wavelength band.
10. A network as claimed in claim 9, characterised by splitting means (110) arranged to receive optical signals from said second drop element (100) and to separate said second wavelength band from said third  
25 wavelength band.
11. A network as claimed in claim 9 or 10, characterised by coupling means (150) arranged to feed optical signals to said second add element (140) and to couple signals carried on said second wavelength band with  
30 signals carried on said third wavelength band.

12. A node as claimed in claims 10 and 11, characterised by a bypass path for said third wavelength band directly connecting said splitting means (110) to said second add element (150).

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Abstract

5 In networks carrying existing optical traffic on one wavelength band in  
combination with wavelength division multiplexed traffic carried on a second  
wavelength band, there is a need to enable processing of the two systems  
without subjecting the WDM channels to unacceptable losses. The invention  
meets the above need by the provision of a node in an optical communications  
network that has a first set of add/drop filter elements for extracting and  
10 combining optical signals carried on wavelength division multiplexed  
channels in a first wavelength band and an extraction element and combining  
element for dropping and adding, respectively, a service channel associated  
with the wavelength division multiplexed channels. The extraction element is  
arranged upstream of the add/drop filter elements relative to the direction of  
15 traffic flow and the combining element is arranged downstream of the  
add/drop filter elements. The extraction and combining elements are  
additionally adapted to drop and add, respectively, at least one further  
wavelength band carrying at least one optical traffic data channel.

20 Fig. 2

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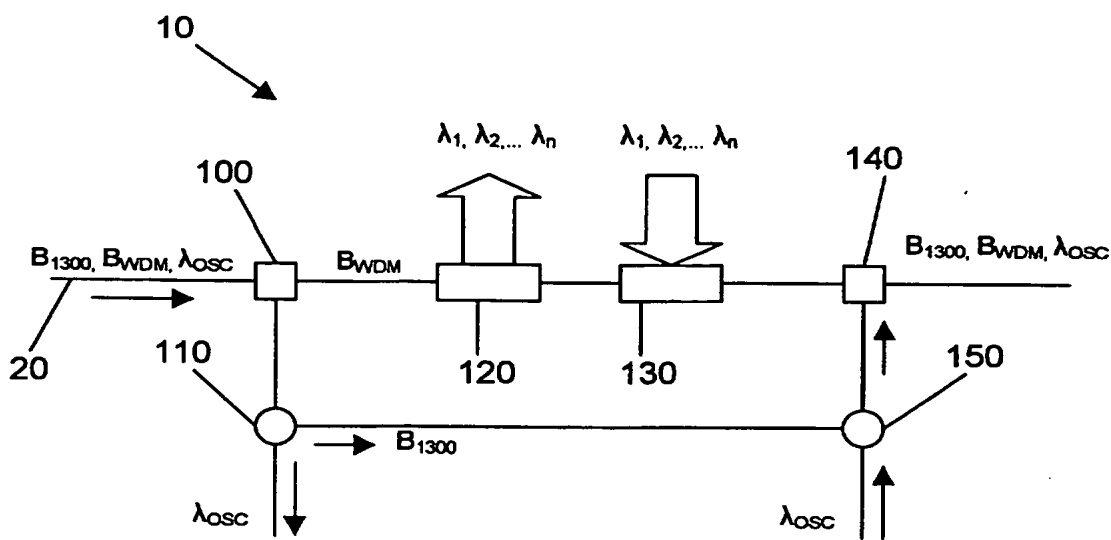


Fig. 3

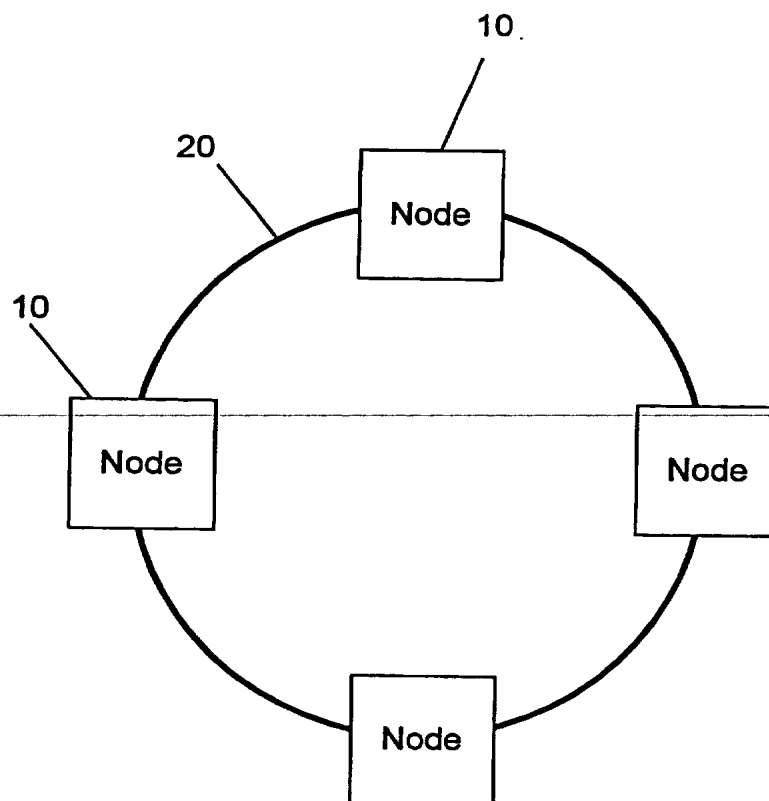


Fig. 1

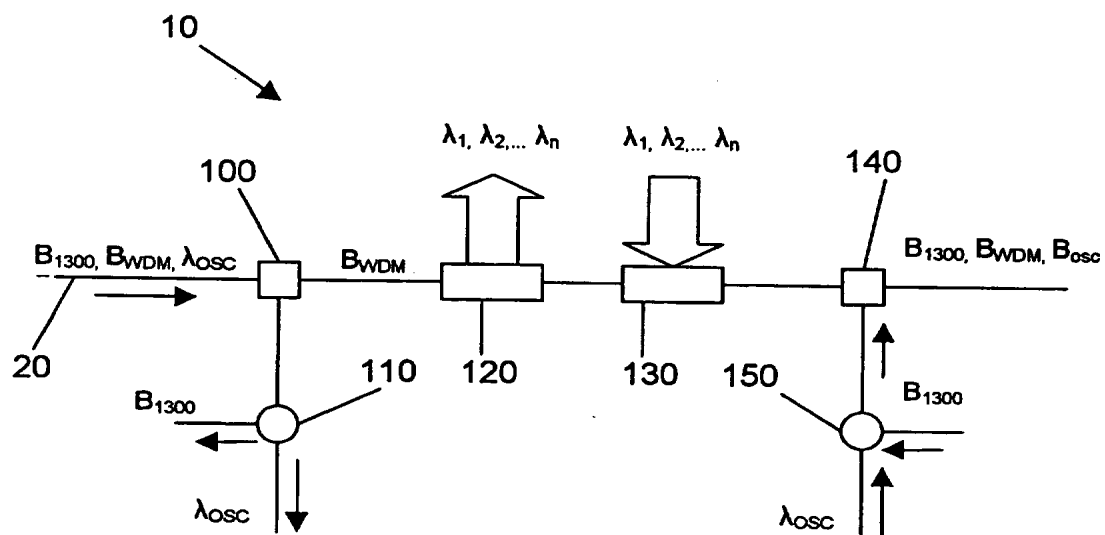


Fig. 2